

# NASA TECH BRIEF



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## Gage of 6.5% Si-Fe Sheet Is Chemically Reduced

### The problem:

In the production of 6.5% Si-Fe soft-magnetic alloy sheet or strip, the brittleness of the material prevents rolling to very thin gages. In certain applications it is advantageous to assemble laminated cores of this material from sheet as thin as 0.006 inch. While such sheet can be produced by rolling, special equipment is required, production rate is relatively low, and reject rate high.

### The solution:

Following conventional rolling to safe gage limits, the material is chemically milled to the desired gage.

### How it's done:

Either of 2 chemical solutions are used to effect the chemical milling of 6.5% Si-Fe strips 12 to 13 inches long, 3 inches wide, and 0.008 to 0.025 inch thick. One solution contains equal parts of hydrochloric acid, nitric acid (both technical grades), and water. The other solution is a mixture of equal parts of phosphoric acid and high purity hydrogen peroxide. Each solution effects uniform metal removal.

The phosphoric acid-hydrogen peroxide solution produces a very smooth nonrusting lustrous surface, but requires close control of the reaction to prevent formation of silicon oxide precipitates on the metal surface. Additionally, these chemicals are relatively expensive. The hydrochloric acid-nitric acid solution

is more suitable for production purposes because of its high rate of metal removal, low cost, and ease of storage and handling.

After chemical milling, the remaining material is coated with a zirconia slurry and annealed in a 0.5-1.0 psi hydrogen atmosphere at 1,000°C. The surface coating is then removed and the material is quality checked for silicon content which should be between 6.0% and 6.5%.

### Notes:

1. Although chemical milling is not new, the above-described process has made the application of 6.5% Si-Fe magnetic material in its present stage of development possible.
2. Inquiries concerning this innovation may be directed to:

Technology Utilization Officer  
Manned Spacecraft Center  
Houston, Texas 77058  
Reference: B66-10454

### Patent status:

No patent action is contemplated by NASA.

Source: D. M. Pavlovic and A. Goldman  
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